

AMENDMENTS TO THE CLAIMS

In the Claims:

Claims 1-16 (Currently Cancelled)

17. (Currently Amended) A method of controlling a progressing cavity pump for transferring fluid within a fluid system, wherein the progressing cavity pump is coupled to an electric motor, the method comprising the steps of:

determining in real-time values of torque and speed inputs to the progressing cavity pump without downhole sensors by measuring electrical voltages applied to the motor and currents drawn by the motor, and using the measured values of electrical voltages applied to the motor and currents drawn by the motor to calculate the values of torque and speed inputs to the progressing cavity pump;

using the real-time values of torque and speed inputs to calculate one or more values representing the performance of the progressing cavity pump;

using the progressing cavity pump performance values to produce one or more command signals; and

using the command signals to control in real-time closed-loop basis the speed of the progressing cavity pump.

18. (Original) The method of claim 17, wherein the step of using progressing cavity pump performance values to produce command signals comprises the steps of:

selecting a progressing cavity pump performance parameter to control;

determining a setpoint for the selected progressing cavity pump performance parameter;

calculating a control signal using the setpoint value of the selected progressing cavity pump performance parameter; and

calculating the command signals from the control signal.

19. (Original) The method of claim 18, wherein the selected progressing cavity pump performance parameter is the pump flow.

20. (Previously presented) A method of controlling a progressing cavity pump for transferring fluid within a fluid system, the method comprising the steps of:

determining values of torque and speed inputs to the progressing cavity pump;
using the values of torque and speed inputs to calculate one or more values representing the performance of the progressing cavity pump;

using the progressing cavity pump performance values to produce one or more command signals; and

using the command signals to control the speed of the progressing cavity pump;
wherein the step of using progressing cavity pump performance values to produce command signals comprises the steps of:

selecting pump flow as the progressing cavity pump performance parameter to control;

determining a setpoint for the selected progressing cavity pump performance parameter;

calculating a control signal using the setpoint value of the selected progressing cavity pump performance parameter; and

calculating the command signals from the control signal; and

wherein the step of using the command signals to control the speed of the progressing cavity pump includes repetitively switching the speed of the progressing cavity pump between a set pump speed for a portion of a cycle period and zero speed for the remainder of the cycle period to achieve an average pump flow equal to the setpoint value of the pump flow.

21. (Original) The method of claim 18, wherein the selected progressing cavity pump performance parameter is the pump head pressure.

22. (Canceled)

23. (Previously presented) The method of claim 17, wherein the step of using progressing cavity pump performance values to produce command signals comprises the steps of:

- selecting a progressing cavity pump performance parameter to control;
- determining a setpoint for the selected progressing cavity pump performance parameter;
- calculating a control signal using the setpoint value of the selected progressing cavity pump performance parameter; and
- calculating the command signals from the control signal.

24. (Original) The method of claim 23, wherein the selected progressing cavity pump performance parameter is the pump flow.

25. (Previously presented) A method of controlling a progressing cavity pump for transferring fluid within a fluid system, the method comprising the steps of:

- determining values of torque and speed inputs to the progressing cavity pump;
 - using the values of torque and speed inputs to calculate one or more values representing the performance of the progressing cavity pump;
 - using the progressing cavity pump performance values to produce one or more command signals; and
 - using the command signals to control the speed of the progressing cavity pump;
- wherein the progressing cavity pump is coupled to an electric motor and the step of determining the torque and speed inputs to the progressing cavity pump includes the steps of measuring the electrical voltages applied to the motor and currents drawn by the motor, and using the measured values of electrical voltages applied to the motor and currents drawn by the motor to calculate at least one of the values selected from the group consisting of motor torque and motor speed;
- wherein the step of using progressing cavity pump performance values to produce command signals includes the steps of selecting a progressing cavity pump performance

parameter to control, determining a setpoint for the selected progressing cavity pump performance parameter, calculating a control signal using the setpoint value of the selected progressing cavity pump performance parameter; and calculating the command signals from the control signal;

wherein the selected progressing cavity pump performance parameter is the pump flow; and

wherein the step of using the command signals to control the speed of the progressing cavity pump includes repetitively switching the speed of the progressing cavity pump between a set pump speed for a portion of a cycle period and zero speed for the remainder of the cycle period to achieve an average pump flow equal to the setpoint value of the pump flow.

26. (Original) The method of claim 23, wherein the selected progressing cavity pump performance parameter is the pump head pressure.

Claims 27-68 (Currently Cancelled)

69. (Currently Amended) A pump control system for controlling a progressing cavity pump for transferring fluid within a fluid system, wherein the progressing cavity pump is coupled to an electric motor, the pump control system comprising:

means for determining in real-time values of torque and speed inputs to the progressing cavity pump, without downhole sensors, by measuring electrical voltages applied to the motor and currents drawn by the motor, and using the measured values of electrical voltages applied to the motor and currents drawn by the motor to calculate the values of torque and speed inputs to the progressing cavity pump;

means for using the real-time values of torque and speed inputs to calculate one or more values representing the performance of the progressing cavity pump; and

means for using the progressing cavity pump performance values to produce one or more command signals for controlling in a real-time closed-loop basis the speed of the progressing cavity pump.

70. (Original) The pump control system of claim 69, wherein said means using the progressing cavity pump performance values to produce command signals includes means for calculating a feedback signal indicative of the difference between a current value of a selected progressing cavity pump performance parameter and a setpoint value of the selected progressing cavity pump performance parameter, and means for calculating the command signals from the feedback signal.

71. (Original) The pump control system of claim 70, wherein the selected progressing cavity pump performance parameter is the pump flow.

72. (Original) The pump control system of claim 70, wherein the selected progressing cavity pump performance parameter is the pump head pressure.

73. (Original) The pump control system of claim 69, wherein said means using the progressing cavity pump performance values to produce command signals includes means for calculating a feedforward signal by predicting a value of mechanical input to the progressing cavity pump when operating with a selected progressing cavity pump performance value at a setpoint value, and means for calculating the command signals from the feedforward signal.

74. (Previously presented) A pump control system for controlling a progressing cavity pump for transferring fluid within a fluid system, the pump control system comprising:

means for determining values of torque and speed inputs to the progressing cavity pump;

means for using the values of torque and speed inputs to calculate the pump flow as a selected value representing the performance of the progressing cavity pump;

means for using the progressing cavity pump performance values to produce one or more command signals for controlling the speed of the progressing cavity pump; and

means for repetitively switching the speed of the progressing cavity pump between a set pump speed for a portion of a cycle period and zero speed for the remainder of the

cycle period to achieve an average pump flow equal to the setpoint value of the pump flow;

wherein said means for using the progressing cavity pump performance values to produce command signals includes means for calculating a feedback signal indicative of the difference between a current value of the selected progressing cavity pump performance parameter and a setpoint value of the selected progressing cavity pump performance parameter, and means for calculating the command signals from the feedback signal.

Claims 75-91 (Currently Cancelled)